AZIMUTH OF LINE BY DIRECT SOLAR OBSERVATION (ALTITUDE METHOD)

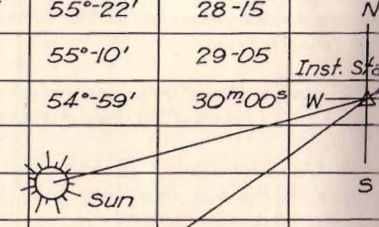
Date: Friday, June 13, 1952; P.M.

Place of observation: University of California Campus, N.W. of Students' Observatory, Berkeley, California.

$\phi = 37°-52'-24"$ N; $\lambda = 122°-15'-42"$ W., or $8^h-09^m-02.8^s$ W. Temperature: 86°F.

Observation Record Sighting Center of Sun.

Point	Telescope	Hor. Vern.	Vert. Circle	Time	Remarks
Mark	Direct	0°-00'		(P.M.)	
Sun	"	35°-31'	55°-49'	$2^h-26^m-35^s$	
Sun	"	35°-52'	55°-35'	27-25	Sketch
Sun	"	36°-12'	55°-22'	28-15	
Sun	"	36°-32'	55°-10'	29-05	
Sun	"	36°-53'	54°-59'	30^m-00^s	
Mark	"	0°-00'			
Mark	Inverted	0°-00'		Mark Sta. D	
Sun	"	37°-13'	54°-49'	$2^h-30^m-55^s$	
Sun	"	37°-34'	54°-38'	31-45	
Sun	"	37°-55'	54°-26'	32-35	
Sun	"	38°-15'	54°-13'	33-25	
Sun	"	38°-36'	53°-59'	34^m-18^s	
Mark	"	0°-00'			
	10)	370°-33'	549°-00'	$20^h-300^m-258^s$	
Averages:		37°-03'-18"	54°-54'-00"	$2^h-30^m-26^s$	



Instrument at Sta. I; Mark at Sta. D.
Watch: 0^m-43^s slow. Equipment: Transit; plumb-bob; chaining pins; range poles; reading glass; watch; white card; colored eye-piece; Am. Eph. & Naut. Almanac; Logarithm Tables; etc.

Problem No. 90.

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Date: Friday, June 13, 1952. (___ hrs.) Fair and Warm.
Party: _____

Computation Record: Watch: 0^m-43^s Slow.

Average watch time of observation (p.m.)	$2^h-30^m-26^s$ P.M.	Reference A.E.&N.A. 1952
Watch correction	$+ 0^m-43^s$	
Pacific Std. Time, 120th Meridian, time of observation (p.m.)	$2^h-31^m-09^s$ P.M.	
Longitude of 120th Meridian (in time)	$8^h-00^m-00^s$	
G.M.T. of observation (p.m.)	$10^h-31^m-09^s$ P.M.	
Greenwich Civil Time of observation	$22^h-31^m-09^s$	
Declination of Sun Greenwich nearest mean midnight, June 14, 1952,	+23°-15'-19.4"	p.8
Correction for $24^h-22^h-31^m-09^s = 1^h-28^m-51^s \times \frac{197.2"}{24} = 1.48083 \times 8.217$	- 0'-12.2"	p.8
Declination of Sun at time of observation (δ)	23°-15'-07.2"	
Subtract from 90°	90°	
Sun's polar distance (p)	66°-44'-52.8"	
Mean observed altitude	+54°-54'-00"	p.8
Correction for parallax: $+8.66" \times \cos 54°-54'-00" = 8.66 \times 0.57501$	+4.98"	Service: p.53
Correction for refraction: (h=54°-54'-00")	-0'-40.9"	0'-35.9" Service: p.55
Corrected Altitude of Sun (h)	+54°-53'-24.1"	
Corrected Altitude of Sun (h)	+54°-53'-24.1"	
Latitude (ϕ)	37°-52'-24"	
Polar distance (p)	66°-44'-52.8"	
(2s)	2) 159°-30'-40.9"	
(s)	79°-45'-20.5"	
(p)	66°-44'-52.8"	
(s-p)	13°-00'-27.7"	

Use:

$$\cos \tfrac{1}{2} A = \sqrt{\frac{\cos(s)\,\cos(s-p)}{\cos(\phi)\,\cos(h)}}$$

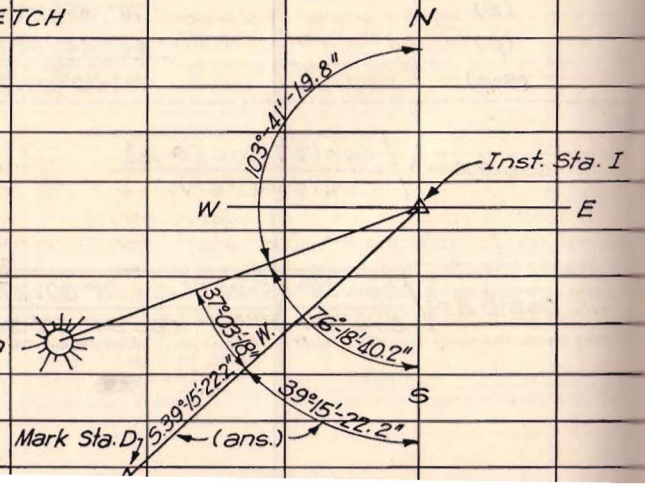
$$\cos \tfrac{1}{2} A = \sqrt{\frac{\cos 79°-45'-20.5"\ \cos 13°-00'-27.7"}{\cos 37°-52'-24"\ \cos 54°-53'-24.1"}}$$

Sheet No. 1

Solar Observation of June 13, 1952 Continued.
Computation Record Continued.

Function		Angle	Logarithm
Log cos (S)		79°-45'-20.5"	9.250043 -10
Log cos (S-p)		13°-00'-27.7"	9.988711 -10
Colog cos	(ϕ)	37°-52'-24"	0.102719
Colog cos	(h)	54°-53'-24.1"	0.240220
Log cos²	½ A	2)	19.581693 -20
Log cos	½ A		9.790847 -10
	½ A	51°-50'-39.9"	
	A	103°-41'-19.8"	
Subtract from		180°	
	A	76°-18'-40.2" Azimuth or bearing of Sun	
Horizontal Vernier (Mean)		37°-03'-18" Mark to left of Sun	
Azimuth of Mark		39°-15'-22.2" Clockwise from South	
Bearing of Line ID		S 39°-15'-22.2" W	

SKETCH



(____hrs.) COMPUTERS _____

SOLAR OBSERVATION FOR AZIMUTH BY THE ALTITUDE METHOD.

FIELD PROCEDURE:

1. Set up transit over North most point of line, if possible.
2. Level plate bubbles very accurately, and set A vernier on zero, upper motion clamped.
3. Sight mark with vertical hair, clamp lower motion, vernier reads zero on mark, telescope direct.
4. Release upper motion, sight center of Sun, clamp upper motion, also clamp vertical circle, and with upper motion tangent screw and vertical circle tangent screw, set accurately as you can on center of Sun, and immediately call time.
5. There are two ways of sighting center of Sun: 1) with colored eye-piece that you look through directly at Sun, or 2) focus cross-hairs on white paper screen. In either case, look at the two horizontal stadia hairs first and be sure not to use them on the center of the Sun. Be sure you use the center cross-hairs.
6. After time is called, read both the A vernier and the vertical circle as rapidly as possible to the nearest minute, calling same to recorder.
7. With tangent screws of upper motion and vertical circle, set on center of Sun again, and again, until five direct sets of readings are obtained.
8. When the fifth reading has been taken, release the upper motion and sight back on mark, vernier A must again read zero. Work must be repeated if the A vernier does not read zero.
9. With A vernier on zero, invert the telescope, sight mark, both motions clamped.
10. Release upper motion and sight center of Sun five times in succession as before, keeping complete record, and finally recheck back on mark.
11. This constitutes the proper field procedure in observing the Sun for azimuth by the altitude method.
12. If watch has not already been checked at the telegraph office, it should be so checked for watch error before computations of the observation is made.
13. An experienced observer can make the ten settings on the Sun in four minutes. The shorter the time interval between the first and last setting the better is the result. The student must not take more than twelve minutes in making the ten sightings. Don't try to make a solar observation when there are many passing clouds for the time interval between the settings will be very irregular.
14. If this procedure is strictly adhered to, no difficulty should be had in obtaining the azimuth of a line to the nearest minute of arc.